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Tillering response of liquid organic fertilizer and monosodium glutamate supplementation on Ganyong (*Canna discolor* Lindl.)

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ABSTRACT. Ganyong (*Canna discolor*) is a plant that contains a high carbohydrate content, utilizing as alternative food for rice, especially in Indonesia. One of the factors affecting growth is the quantity of tillers, which affect the productivity of Ganyong's tuber. The purpose of this study was to discover the optimal combination of liquid organic fertilizer and monosodium glutamate to enhance the number of tillers. This study employed a randomized complete block design with a two-factor structure. The first factor to consider was the concentration of liquid organic fertilizer, which was specified as 0 ml/L, 2 ml/L, 3 ml/L, and 4 ml/L. The second factor was the monosodium glutamate dosage, which ranged from 0 to 3 g/plant, 6 g/plant, and 9 g/plant. Ganyong were cultivated for six months on farmland at an elevation of 460 m asl. Supplementation with liquid organic fertilizer resulted in a significant increase in the number of tillers. While monosodium glutamate supplementation had no significant effect on the formation of tillers. Combining liquid organic fertilizer at a concentration of 3 ml/L with monosodium glutamate 6 g/plant resulted in the optimal number of tillers.

Keywords: monosodium glutamate dosage; organic fertilizer concentration; rhizome of Ganyong; randomized complete block design; white Ganyong

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INTRODUCTION

Canna discolor Lindl. also known as Ganyong (Indonesia) is an origin plant from Northern South America disseminated to Asia's subtropical and tropical areas (Matoba *et al*., 2011; Ciciarelli & Passarelli, 2020). In Indonesia, two varieties of Ganyong are known by various local names: white Ganyong and red Ganyong. Red Ganyong is distinguished by its red or purple stems, leaves, and midribs, whereas white Ganyong has green stems, leaves, midribs, and brownish tuber scales (Dinas Pertanian dan Pangan Kabupaten Demak, 2021). This herbaceous plant's vegetative parts are waxy. Its stem can reach a height of 0.9 to 1.8 m. The leaves are grouped with a prominent midrib and are occasionally short-stemmed. Horizontally branched tubers, with fleshy segments forming a balloon, covered by thin leaves and thick, fibrous roots. Tubers are pinkish or yellowish-white on the outside and yellowish-white on the inside. Ganyong tubers mature to a brownish color because of their thick covering (Al-Snafi, 2015; Latifah & Prahardini, 2020). Ganyong is a versatile plant that thrives in all types of weather and is tolerant of dry soil. Ganyong production can reach 50 tons of stover or 35 tons of tubers per hectare per growing season on Indonesian land (Balai Pengkajian Teknologi Pertanian Kalimantan Timur, 2017).

Despite the fact that Ganyong has not been commonly cultivated in Indonesian society, it contains a high carbohydrate as an energy source (Kuswandari *et al*., 2013; Noriko & Pambudi, 2015; Carolina & Ilmi, 2016). Additionally, ganyong tubers contain secondary metabolites of inulin that act as prebiotics, providing sustenance for probiotic bacteria (Cui *et al*., 2018; Sulandari & Pangesthi, 2018). Mudannayake *et al.* (2015) found inulin-type fructan of *Canna indica* L. (green) and *Canna indica* L. (red) were 0.1 g/100 g FW and 0.67 g/100 g FW, respectively. Ganyong can be utilized as a substitute foo, concerning the varieties and composition. As a result, it possesses immense potential as a cultivated plant, as measured by the increasing number of tillers (Rahayu & Wijayanto, 2014). To accomplish this, plants require an adequate

supply of protein. The addition of liquid organic fertilizer and monosodium glutamate are two cultivation approaches that can be utilized. Fertilization with organic matter, chemical fertilizer, or referred to as nanotechnology liquid fertilize can provide the nutrients necessary, then boost the total output of plant (Suge *et al*., 2011; Ekinci *et al*., 2014; Gao *et al*., 2020).

Liquid organic fertilizer can increase the number of shoots on the plant, which can have an effect on the tuber formation (Mardin & Dewanto, 2013; Saputri *et al*., 2021). Absorbed nitrogen is assimilated into amino acids and used in the synthesis of chlorophyll, protein, and other secondary metabolites in plants (Wen *et al*., 2019; Akmakjian & Bailey-Serres, 2020). The use of liquid organic fertilizer is more compelling due to the fact that it is absorbed by the leaves stomata (Pratami *et al*., 2015; Ginandjar *et al*., 2019), and provides the maximum amount of biomass to plants (Widiastuti & Latifah, 2016). Monosodium glutamate, which contains glutamate, sodium, and water, may aid in photosynthesis by increasing photosynthate production (Gresinta, 2015; Khair *et al*., 2018).

Although production of liquid organic fertilizer and monosodium glutamate has been investigated in other plants, it has not been done in *C. discolor*. However, several studies have demonstrated that excessive fertilizer application results in plant growth disorders. As a result, it is necessary to conduct thorough research on the addition of liquid organic fertilizer and monosodium glutamate. This study aims to determine the effect of liquid organic fertilizer and monosodium glutamate on the number of tillers and to determine the optimal combination of the two. These two ingredients have been formulated to address the needs and challenges of farmers and entrepreneurs in agriculture and plantations in order to achieve superior yields or harvests, and thus to contribute to national food security.

MATERIALS AND METHODS

The combination formula. White Ganyong was cultivated in Plumbon Village farmland, Temanggung Regency, with 460 m above sea level for six months. The rhizome of Ganyong tubers was used for planting, then treated as the formula in Table 1.

Table 1. The combination formula of liquid organic fertilizer and monosodium glutamate in this study.

Code	Treatment
P0M0	Control (without LOF or MSG)
P0M1	LOF 0 ml/L + MSG 3 g/plant
P0M2	LOF 0 ml/L + MSG 6 g/plant
P0M3	LOF 0 ml/L + MSG 9 g/plant
P1M0	LOF 2 ml/L + MSG 0 g/plant
P1M1	LOF 2 ml/L + MSG 3 g/plant
P1M2	LOF 2 ml/L + MSG 6 g/plant
P1M3	LOF 2 ml/L + MSG 9 g/plant
P2M0	LOF 3 ml/L + MSG 0 g/plant
P2M1	LOF 3 ml/L + MSG 3 g/plant
P2M2	LOF 3 ml/L + MSG 6 g/plant
P2M3	LOF 3 ml/L + MSG 9 g/plant
P3M0	LOF 4 ml/L + MSG 0 g/plant
P3M1	LOF 4 ml/L + MSG 3 g/plant
P3M2	LOF 4 ml/L + MSG 6 g/plant
P3M3	LOF 4 ml/L + MSG 9 g/plant

Notes: LOF= liquid organic fertilizer; MSG= monosodium glutamate.

Ganyong planting and observation. This study is a continuation of our previous investigation (Suprapto *et al*., 2021). The bed in this study was 140 cm x 270 cm in size and 25 cm in height. The altimeter was used to determine the land's height, and the soil tester was used to determine the land's potential hydrogen. The addition of liquid organic fertilizer is accomplished by first watering the plants according to the concentration, 200 ml per plant. After 21 days, fertilization was applied via spraying on the leaf surface at the treatment concentrations of 0 ml/L, 2 ml/L, 3 ml/L, and 4 ml/L. Fertilization was performed on a biweekly basis. Monosodium glutamate is added in the following doses: 0 g/plant, 3 g/plant, 6 g/plant, and 9 g/plant by sprinkling it around the plant in a circle that has been drilled previously. The number of tillers was counted once a week.

Data analysis. The number of tillers in this study were analyzed using SPSS ver. 25, with the ANOVA test at a 95% confidence level (α= 0.05). The significant data is followed by orthogonal polynomial test (James & van Iersel, 2001).

RESULTS AND DISCUSSION

The number of tillers was counted once a week during this study. There were 48 Ganyong accessions observed. Fig. 1 depicts the number of tillers, and Table 2 contains the analysis of variance result.

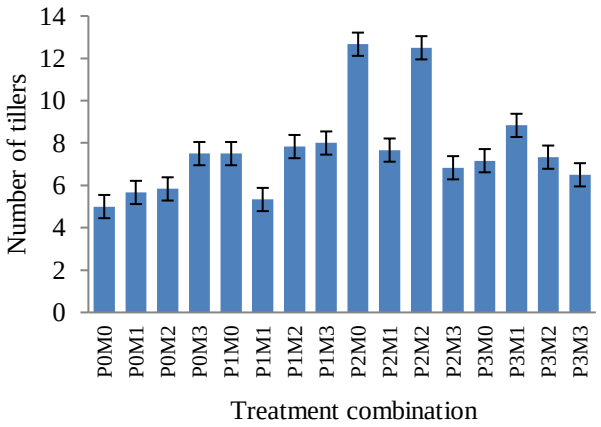

Fig. 1. Number of tillers of *Canna discolor* on adding combination of liquid organic fertilizer and monosodium glutamate.

The average number of tillers was identical between the control and the treatment with a liquid organic fertilizer 2 ml/L + monosodium glutamate 3 g/plant (P1M1). Numerous combinations of treatments had the same effect on the number of tillers, including P0M3, P1M0, P1M2, P1M3, and P2M1. Combining the two treatments frequently results in inhibition, some plants do not respond to all treatments (Silitonga *et al*., 2018). It can occur due to a plant's genetic profile or environmental conditions that are incompatible with the plant's requirements. The combination of 3 ml/L liquid organic fertilizer without monosodium glutamate (P2M0) and 3 ml/L liquid organic fertilizer with 6 g/plant monosodium glutamate (P2M2) produced the most tillers in this study. The addition of liquid organic fertilizer and monosodium glutamate provides the necessary nitrogen. This study demonstrated that applying fertilizer at the correct concentration and dose can increase nutrient uptake, particularly nitrogen (Hammad *et al*., 2017). Additionally, the data were analyzed using ANOVA, as illustrated in Table 2.

Table 2. Analysis of variance for liquid organic fertilizer and monosodium glutamate supplementation to number of tillers of *Canna discolor*.

Effect	Degrees of freedom	Sum of square	Middle square	F value	Sign	F table 0.05	0.01
Block	2	15.09	7.55	5.54	**	3.32	5.39
Treatment	15	61.61	4.11	3.01	**	2.01	2.70
Liquid organic fertilizer	3	29.85	9.95	7.30	**	2.92	4.51
Monosodium glutamate	3	5.48	1.83	1.34	ns	2.92	4.51
Interaction	9	26.28	2.92	2.14	ns	2.21	3.07
Error	30	40.88	1.36				
Total	47	117.58					

Notes: *= result shown significantly in α 0.05; **= result shown significantly in α 0.01; ns= not significantly.

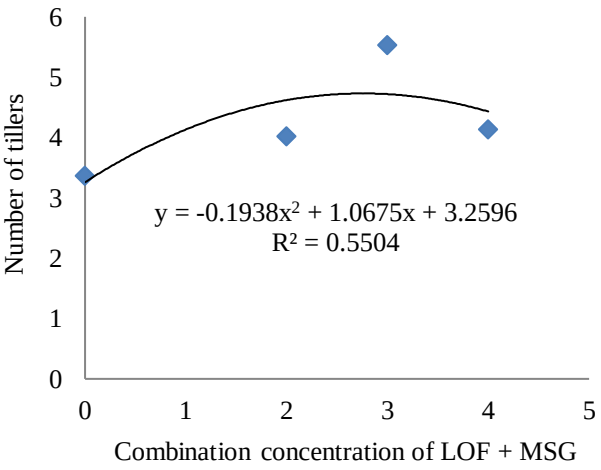

Fig. 2. Effect of liquid organic fertilizer and monosodium glutamate on number of tillers of *Canna discolor*.

The addition of monosodium glutamate was not significantly different from the addition of liquid organic fertilizer, as determined by the orthogonal polynomial test. There was no interaction between combination of a liquid organic fertilizer and monosodium glutamate in this treatment (Fig. 2).

According to the orthogonal polynomial test, treating with liquid organic fertilizer on 3 ml/L produces the optimum results. A low concentration of liquid organic fertilizer is insufficient to provide *C. discolor* with the nutrition it requires. Otherwise, an excessive concentration of nitrogen fertilizer can cause growth plant disorders, posed serious threats to

environment and human health (Liu *et al*., 2014; Ahmed *et al*., 2017). Apply liquid organic fertilizer to the treatment by watering first, after 21 days, foliar fertilization is performed by spraying liquid organic fertilizer on the leaf surface. This treatment facilitates plant nitrogen absorption through the oxidation process, which use for photosynthesis. The result of photosynthesis is then transferred from leaves to all organs, resulting in stimulated shoots. In other studies, low nitrogen fertilization was stimulate the production of carbon based secondary metabolites, availability generally results in increased phosphor cycling rates, providing a mechanism for plants and ecosystems to adapt to changes in nitrogen and phosphor supplies (Ibrahim *et al*., 2011; Marklein & Houlton, 2011). The addition of liquid organic fertilizer to shallots resulted in a more significant number of tillers than the control treatment (Nugrahini, 2013). Additionally, monosodium glutamate supplementation aids in the fulfillment of nitrogen Ganyong requirements. Singh *et al.* (2011) and Haghighi *et al.* (2015) stated monosodium glutamate-wastewaters could be used as fertilizer sources because they contain a high concentration of nitrogen, which promotes corn growth and increases the fresh weight of shoots and roots. Monosodium glutamate usage facilitated the continuation of green practices without impairing soil properties. Because it significantly increases the number of tillers, the combination of liquid organic fertilizer and monosodium glutamate supplementation can be used as a reference for the white Ganyong cultivation technique.

CONCLUSION

The application of liquid organic fertilizer affects the number of tillers, while monosodium glutamate does not significantly increase the number of tillers in *Canna discolor*. A combination of liquid organic fertilizer at 3 ml/L and monosodium glutamate at 6 g/plant can significantly increase the number of tillers in *C. discolor*.

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